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COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENHANCED VEHICLE INSPECTION & MAINTENANCE

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Massachusetts Hybrid Program Description

March 27, 1996

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Executive Summary

Over the next three years the **Massachusetts Hybrid Vehicle Emissions Inspection and Maintenance Program** will transform emissions testing in the Commonwealth by introducing modern testing equipment, computerized quality control, and technician training for the efficient repair of polluting cars. Cars will need to be tested only once every two years, instead of once each year, yet the Massachusetts Hybrid will achieve greater environmental protection than the existing system. This difference in efficiency is due to the current system's reliance on an obsolete idle test, poor quality control, and a failure to curb sticker fraud. DEP proposes to fully implement the new Massachusetts Hybrid testing program by 1999.

The **Massachusetts Hybrid** offers motorists the most cost-effective and consumer-friendly method available to achieve significant reductions in air pollution. The Massachusetts Hybrid:

- uses a modern, computerized dynamometer-based testing system to achieve measurable results in a cost-effective manner and give motorists the best possible test for their money.
- relies upon partnerships between private contractors, test stations, and DEP to ensure that the test is delivered consistently across the Commonwealth, and to promote accurate and efficient repairs.
- focuses upon the needs of Massachusetts drivers by retaining convenient neighborhood locations for the test and an overall cost similar to the existing inspection.

The Hybrid is . .

- ☑ dynamometer testing for accuracy
- ☑ tests once every 2 years
- ☑ tests in local garages & service centers
- ☑ training for repair technicians
- ☑ automated quality control
- ☑ costs similar to the existing system
- ☑ a 3-year phase-in with biennial dynamometer testing starting in 1999.

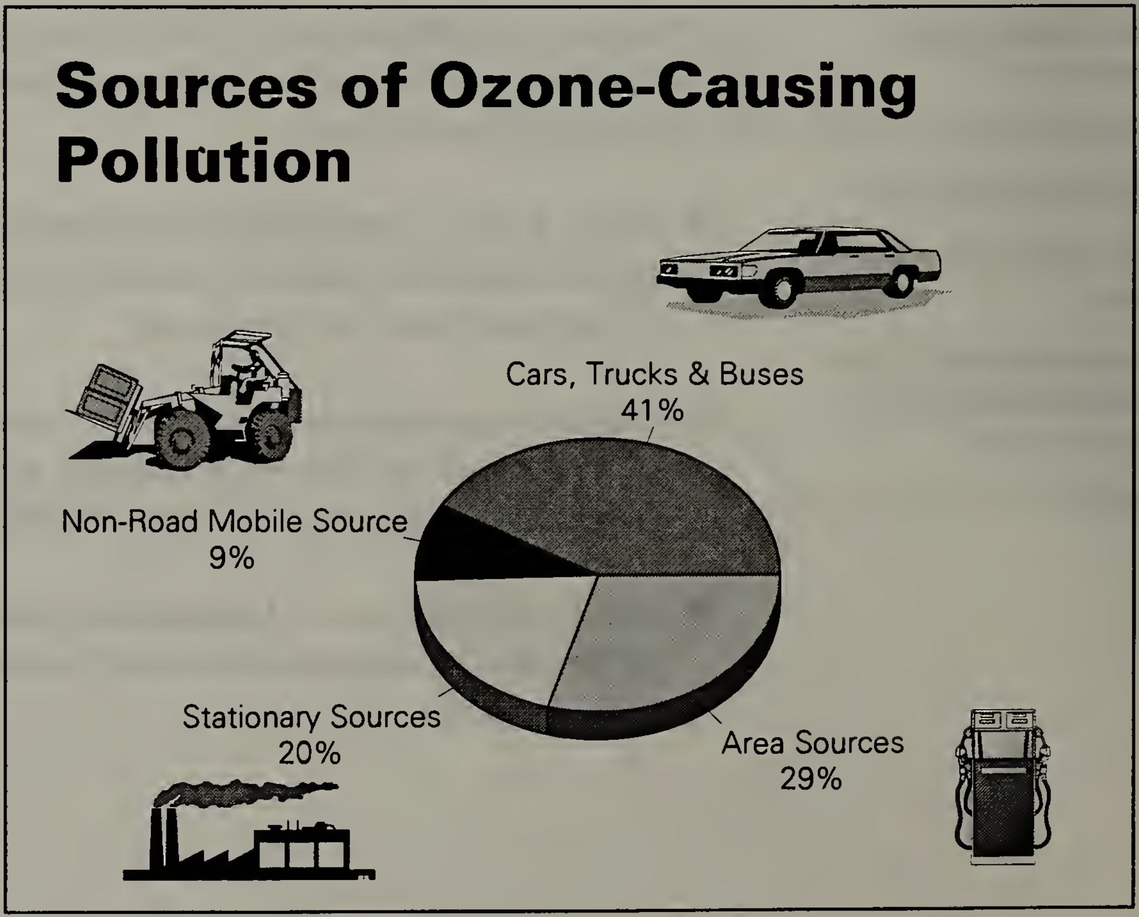
- simplifies repairs by providing technicians with comprehensive data from the dynamometer test showing clearly the conditions that caused a car to fail.

The Need for a New Emissions Test

Every summer in Massachusetts, ozone pollution exceeds federal clean air standards and threatens the health of over 700,000 Massachusetts citizens who have respiratory problems such as asthma. This results in complications to existing illnesses and increased hospital admissions, both of which drive up the cost of health care. Since cars, trucks, and buses are now the largest contributors to air pollution in the state, it makes sense to focus a significant part of our efforts to reduce the ozone problem on these sources.

The two primary precursors of ozone pollution are oxides of nitrogen (NO_x) and hydrocarbons (HC). The current idle emissions test is incapable of identifying vehicles that produce excessive NO_x, and can identify only a small portion of excess HC pollution. The current test also cannot detect hydrocarbons that evaporate from a car's fuel system, nor can it test for smoke from diesels.

The Massachusetts Hybrid, however, can measure both NO_X and HC, and identify leaky fuel systems. The Massachusetts Hybrid also provides incentives to reduce pollution from diesel cars, trucks, and buses, and will begin testing diesels for excess pollution.


Sources of Ozone-Causing Pollution

To solve the problems found in the existing test system, the Massachusetts Hybrid will use modern quality control methods to ensure integrity in the entire test process. These techniques will include real-time data transfer during the test to consistently match vehicle identification numbers to test results, computer-generated stickers, statistical process control of the test, data and performance audits, and prompt, effective enforcement.

Benefits from the Massachusetts Hybrid

The Massachusetts Hybrid's combination of an effective test, delivered with continuous attention to quality, and technical assistance to the repair industry will yield the following benefits for the Commonwealth:

Cleaner Air. The Massachusetts Hybrid will prevent over 130 tons of ozone-causing pollution from entering our atmosphere each day (more than 25% of all such pollution from cars). It can do this because it (1) uses a sophisticated dynamometer test to accurately identify high polluting cars; (2) promotes effective repair of failed vehicles; (3) increases public awareness of cars' role in creating pollution and the importance of maintaining cars; and (4) introduces testing of diesel cars, trucks, and buses in Massachusetts for the first time.

Less Regulation of Massachusetts Drivers. The Massachusetts Hybrid requires an emissions inspection once every two years, instead of once every year. It also provides a three-year exemption for new, low emission vehicles, and keeps the test fee affordable (comparable to what motorists pay today).

Convenient, local test locations. The Massachusetts Hybrid gives virtually all drivers easy access to a local garage or service center within a few miles of where they work or live. It allows repair shops to continue offering one-stop shopping for consumers who want to get their test and any needed repairs at the same location. It also opens the testing field to a variety of business, giving consumers greater choice and flexibility.

"Clean Screen" Pilot Study. The Massachusetts Hybrid includes a remote sensing pilot study for Berkshire County to "clean screen" vehicles. The study will first determine whether remote sensing can accurately identify clean cars on the road. If successful, then a clean screen program will be piloted in Berkshire County to test the public's reaction to the new technology. In the clean screen pilot, drivers of "clean" cars would be sent a "pass" sticker in the mail, thus saving them the time and cost of the standard emissions test.

Three-Year Phase-In

The **Massachusetts Hybrid** will be phased in over a three-year period to ensure that the transition from the current program is smooth and trouble-free for consumers, testing stations, and repair technicians. The three-year phase-in will allow sufficient time for the inspection network to be established and tested, and for repair technicians to be trained on the new equipment. The phase-in will also allow repair garages and service centers to begin offering the dynamometer test early if they choose to do so.

The implementation will have three phases: design and training (1996-1997); systems implementation (1997-1998); and full fleet testing (1999+). The proposed schedule assumes that enabling legislation will be enacted in 1996. Routine biennial dynamometer testing will begin for motorists in 1999.

1996 | **1997** | **1998** | **1999**

Design & Training

- Begin public education and technician training.
- Issue specifications for new testing equipment.
- Establish electronic communication network.
- Hire network contractor.

Systems Implementation

- Require new analyzers for all test stations
- Collect data to demonstrate program effectiveness.
- Begin testing large private fleets and state cars on dynamometers.
- Start field testing remote sensing in Berkshire County.

Full Fleet Testing

- Routine biennial dynamometer testing.

Overview

Over the next three years the Department of Environmental Protection (DEP) will replace the existing vehicle emissions test with an advanced dynamometer-based system known as the **Massachusetts Hybrid**. The objectives of the Massachusetts Hybrid are: (1) to identify high polluting cars, and (2) to promote accurate repair of those vehicles, to reduce air pollution. This change is needed because the 13-year-old idle test is now obsolete and inefficient for modern vehicles. Switching to the Massachusetts Hybrid will result in cleaner air at a lower cost for motorists.

This proposal contains three sections: (1) an outline of the components of the Massachusetts Hybrid; (2) a schedule for phasing-in each component; and (3) a set of questions and answers regarding air quality, testing technology, the Clean Air Act, and other states' programs.

Features

of the Massachusetts Hybrid

☑ **2-year test cycle** instead of the current annual test
☑ **Abundant test locations** in local garages and service centers
☑ **Dynamometers** for accuracy and efficiency
☑ **Diesel testing** for diesel cars, trucks, and buses .
☑ **Auditing & quality control** for consumer protection
☑ **Extended grace period** for failed vehicles
☑ **Intensive public education**
☑ **Affordable cost,** comparable to current test
☑ **Repair technician training** to improve repairs
☑ **Three-year phase-in** with routine dynamometer tests in 1999

Cleaner Air at Lower Cost

Motorists have a right to expect that environmental programs will be efficient, convenient, well-planned, and effective at reducing pollution. With these expectations in mind, DEP designed the Massachusetts Hybrid around four guiding principles: achieve **measurable results**, consider the **motorist first**, rely on the **market**, and **streamline** the process.

Measurable Results

By identifying and repairing high polluting vehicles, the Massachusetts Hybrid will prevent more than 130 tons of ozone-causing pollution from entering the air each day. This means that the program will prevent more than 25% of all pollution coming from cars and trucks.

The key to such success is the use of **dynamometers**. Dynamometers are effective because they allow the test to mimic a car's performance on the road. Simulating road conditions is important because: (1) a car doesn't produce measurable amounts of NO_x until the engine is operating under a load, and (2) a modern car's computer-controlled engine can run very differently during acceleration, deceleration, and while cruising.

Ozone is the state's primary air pollution problem. Ozone is formed by **hydrocarbons,** oxides of nitrogen (**NO_x**), sunlight, and warm temperatures.

Cars, trucks, and buses are the largest single source of these compounds, contributing over 1/3 of all ozone-causing pollution.

Without a dynamometer, emissions tests are less accurate, reductions in hydrocarbons are much lower, and reductions in NOx are minimal. Repairs to cars tested at idle result in less than 1% reduction in NO_x. Programs that use dynamometers can achieve NOx reductions more than 20 times greater than idle tests. With a dynamometer test, a technician can identify a car producing high amounts of NOx, as well as determine precisely the conditions under which the problem occurs. This makes repairs quicker and less costly.

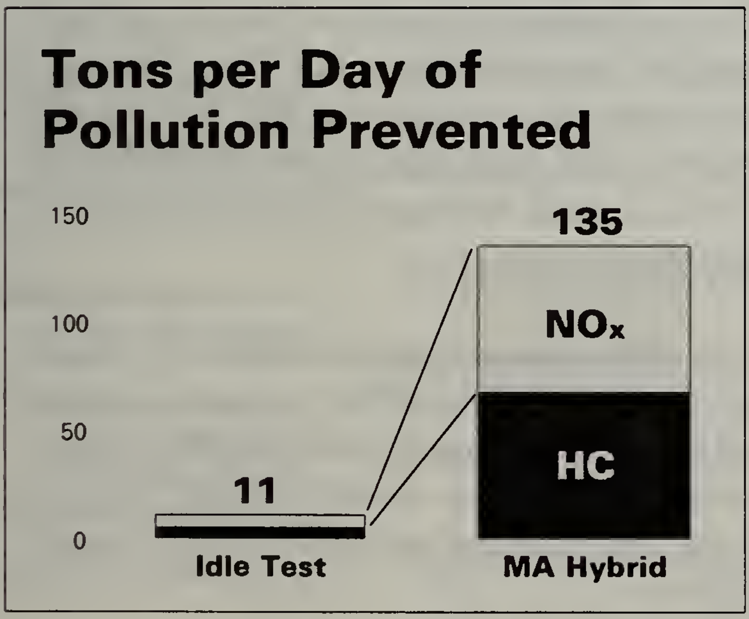
Inspecting and repairing cars is an effective way to control air pollution because vehicles are the single largest contributor to hydrocarbons and NOx. Although cars are much cleaner now due to modern emission controls, these systems still deteriorate and fail, thus causing even a relatively new car to pollute as much as an older model. Because inspection and maintenance is such an effective air pollution control strategy, the Massachusetts Hybrid is a major component of DEP's plan to improve the quality of the state's air, while allowing for future economic growth.

Motorists First

Putting the motorist first means making sure that the program is understandable, easy to participate in, and worth drivers' time and money. Putting the motorist first is crucial for vehicle inspection because individuals, rather than industries, are being asked to participate directly in protecting the environment.

Understandable. The success of recycling programs and "green" products demonstrates that people are willing to take action to protect the environment if they understand the problem. For this reason DEP will launch a widespread public information campaign to show drivers how they can protect the air by maintaining their vehicles. DEP will reach out through the media, direct mail, the Internet, garages, service centers, and schools to let the public know that they can play a major role in protecting their own health by participating in the Massachusetts Hybrid. This campaign will begin in 1996 to allow sufficient time to reach the public and build support before the Massachusetts Hybrid is fully implemented.

Easy. The Massachusetts Hybrid is far more convenient for motorists than the current system because cars will be inspected once every two years instead of once each year. The Massachusetts Hybrid can achieve better results with half the inspections because it uses a dynamometer-based test. Since the inspections will be performed in local garages and service centers, motorists will still find inspection stations plentiful and convenient. To ensure that motorists are satisfied with the program, DEP will monitor customer satisfaction, conduct audits, and will take prompt action to remedy problems.



Worth their time & money. The Massachusetts Hybrid makes economic sense because it prevents much more pollution than the existing idle test at a comparable cost. In other words, the Massachusetts Hybrid will give Massachusetts drivers **more for their money**. Most emissions repairs will pay for themselves through better fuel economy, and the repairs promoted by the program will tend to increase vehicle longevity. This is why inspection and maintenance programs, such as the Massachusetts Hybrid, are among the most cost effective means of controlling air pollution. DEP's outreach plan will help the public understand why the idle test is obsolete and why switching to the dynamometer test has economic as well as environmental benefits.

Use of the Market

The Massachusetts Hybrid allows both government and the private sector to do what each does best. DEP will set performance standards and ensure compliance. The private sector will run the inspection business, provide test equipment, perform repairs, and serve customers. Unlike previous plans from EPA, the Massachusetts Hybrid will allow a variety of businesses to offer inspections and let market forces determine the optimal size and location for test stations.

DEP's proposal also makes use of market forces to prevent pollution from heavy duty diesel vehicles. The Massachusetts Hybrid includes a tax incentive for converting these vehicles to cleaner alternative fuels such as natural gas, and for retrofitting conventional engines to meet stricter pollution standards.

Streamlining

In addition to requiring fewer inspections, the Massachusetts Hybrid will use modern technology to streamline inspections, repairs, quality control, and enforcement. For inspection station owners, the Massachusetts Hybrid will provide financing assistance to make purchasing or leasing the testing equipment easier, and will also eliminate costly maintenance contracts by allowing stations to electronically communicate with DEP. The computers in the test equipment will automate inspections and guide shop owners through calibration and routine maintenance, with higher quality inspections as the result. The modern test equipment will also streamline repairs by providing data that show exactly what conditions caused the vehicle to fail. In addition, computerized auditing techniques, such as statistical process control, will make DEP's enforcement of quality standards fast and consistent.

Enforcement. The Massachusetts Hybrid also simplifies enforcement by eliminating the complex waiver procedures included in EPA's original inspection plan. Instead, failed vehicles will be given a substantial grace period, after which the vehicle must either be repaired to pass, sold, or taken off the road. This approach eliminates the bureaucracy and confusion that result from processing waivers, and treats every vehicle fairly.

Tomorrow's Technology. DEP will regularly evaluate new technology in search of methods to save the public time and money. For example, DEP will test a "clean screen" program in Berkshire County based on remote sensing. If the technology proves effective, this pilot could exempt about a quarter of that county's vehicles from the standard emissions test. This experimental use of remote sensing to "clean screen" is a national innovation, and will be watched closely by other states and EPA.

Program Components

This section outlines the principal components of the Massachusetts Hybrid. These components will be phased in between 1996 and 1999 according to a schedule designed to minimize difficulty and confusion. This schedule is described in detail beginning on page 17. All of the program components except the dynamometers will be in place by the end of 1997. Routine biennial dynamometer testing will begin for most motorists in 1999.

3.7 million vehicles (approx.) will be subject to the test.

2400 stations are in the current test network

DEP will evaluate networks with **1000-1800 stations** for the Massachusetts Hybrid

Test Frequency and Coverage

Starting in 1999, each passenger car and truck (up to 26,000 pounds) made after 1980 will be subject to the emissions test once every two years. DEP will mail a notice to vehicle owners when they are due for their emissions test.

Test Station Network

DEP will work with the automotive business community to develop a network of local, privately operated testing firms, largely based on the existing test network. Most of these firms will also perform engine repairs, but the testing network will be open to other businesses as well. DEP will use network contractors to ensure a mix of large and small test stations with a convenient geographic distribution. The contractors will help smaller firms to participate by leasing the test equipment to each inspection station and charging a fixed fee per test to recover the cost. This decentralized network will allow motorists to choose among hundreds of participating neighborhood repair shops for their emissions tests where they can enjoy the same convenience they have today: one-stop shopping for tests, repairs, and retests. The network will also provide options for motorists who would prefer to obtain their test from a business that does not do emissions repairs.

Network Contractors

DEP will contract with private firms to (1) ensure sufficient participation in the test network, (2) provide adequate geographic coverage, (3) create an electronic network linking all of the test stations, (4) ensure quality and consistency in the test process, and (5) certify, purchase, and distribute test equipment.

DEP's choice of how to select a network contractor is an opportunity to introduce additional competition into the emissions testing program. The Massachusetts Hybrid already encourages competition among garages and test centers to provide inspections and among manufacturers to provide test equipment.

Options for selecting a network contractor include: (1) allowing competition for a single statewide contract, (2) statewide competition for multiple contracts, (3) two or three geographic zones with competition for a single contract in each zone, and (4) single contracts let separately by function (i.e. data management, financing, quality control). Each of these options has its merits and its costs. DEP will maintain sufficient flexibility to explore and implement different options. DEP is in the process of consulting with the repair industry and potential contractors to determine the most efficient option.

Test Equipment Purchase

Equipment required to perform the emissions test will include a dynamometer, gas analyzer, fuel system pressure tester, and the computer hardware and software necessary to link this equipment to DEP's emissions database. This equipment suite is expected to range in cost from $25,000 to $35,000 if produced in quantity. DEP is currently evaluating two options for the purchase of test equipment for the network:

1. Require test stations to purchase or lease directly from equipment manufacturers. Test equipment would be certified by DEP for use in the program. Neither DEP or its contractors are involved in the purchase and distribution of equipment, so this option has the lowest administrative cost. The total number of test stations would be limited by the market, favoring larger firms with better access to capital, and high volume stations.

2. Use network contractor(s) to purchase all of the equipment and then distribute it to test stations. The network contractors would charge each station a 10% deposit and a fee for each test performed to recover the cost of the equipment purchase. To avoid underutilization of test equipment, stations not performing a prescribed minimum number

tests per month would be assessed a fee in lieu of the per-test fee to defray the cost of the equipment. DEP would use this approach to favor small businesses by subsidizing low volume stations with revenue generated from high volume stations. The number of stations choosing to participate will be determined by the market through the amount of the minimum monthly payment.

3. A combination of these two that allows stations to choose between a fee-test arrangement and direct purchase of their own equipment.

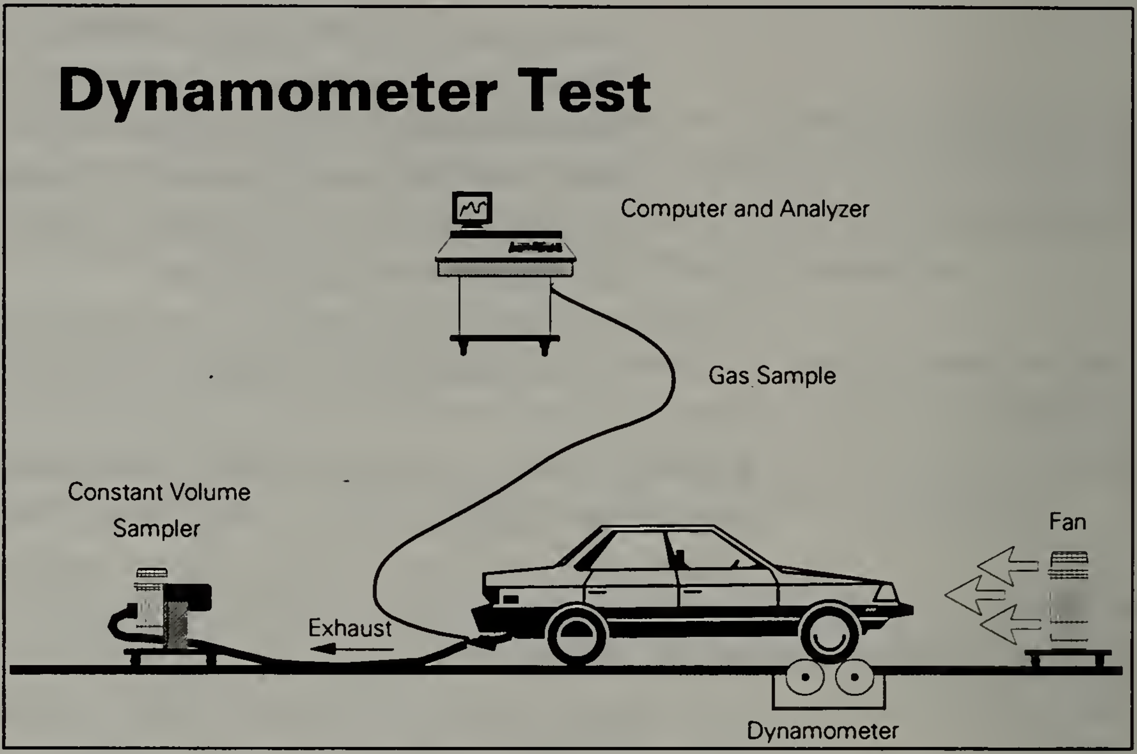
Based on the need to ensure adequate participation in the network and strong support from the repair industry, DEP plans to implement the fee-per-test option over the entire network. Although the contractor will provide the testing equipment, stations will still have the opportunity to select equipment from any manufacturer whose equipment meets state specifications. The details of how the system will work will be refined in consultation with the repair industry and potential contractors prior to the issuance of RFPs for the network contractors.

Test Process

At the inspection station, the emissions inspector will use a bar-code reader to enter the vehicle identification number (VIN) directly into a computer linked to the Commonwealth's vehicle registration database. Then the inspector will collect the test fee, which will be uniform statewide. The inspector will secure the vehicle and "drive" it briefly on a dynamometer to simulate actual driving conditions while a computerized gas analyzer measures pollutant levels. Exhaust gases will be measured while the car accelerates, cruises, and decelerates. The function of the vehicle's vapor purging system will also be tested while on the dynamometer. Readings from the vehicle's on-board diagnostic computer may also be collected to aid in repairs and research. The inspector will then complete a pressure test of the fuel system and give a computer-generated report to the motorist.

The computer will transmit the test results into the state's vehicle registration database. If the vehicle has passed, a pass sticker listing the vehicle's make, model, and VIN will be automatically printed at the time of the test. The automated printing of stickers will eliminate the potential for illegal sale of pre-printed stickers, since each sticker will be valid for only one specific vehicle, and will contain an encrypted bar code of the VIN.

Approximately 80% of the subject fleet is likely to pass the emissions test on the first try. If a vehicle fails the test, a "fail" sticker will be automatically generated and issued at the time of the test. The system will also generate a diagnostic report explaining the specific part of the test that the vehicle failed. The inspector will



Dynamometer Test

provide the driver with a copy of this customized report and a list of nearby businesses employing registered emissions repair technicians.

Repair Incentives

As with other types of automotive work, consumers can choose whether to fix their car immediately, drive it for a limited time while saving the money to fix it, or sell it. The Massachusetts Hybrid incorporates a variety of incentives to encourage motorists to seek effective repairs.

Free Retest Incentive. For any vehicle repaired and retested within 60 days of an initial failure, the retest is free at any certified emissions inspection station. The emissions inspector will give the drivers of failed vehicles a list of businesses in their area employing registered repair technicians. Registered technicians can offer consumers the benefit of up-to-date training and specialized emissions repair skills, although repairs may be obtained from any other mechanic. Do-it-yourself repairs are also allowed.

Grace Period. The grace period allows a consumer to continue driving the failed vehicle for a limited time. If the vehicle then passes an emissions retest sometime during the grace period, it receives a "pass" sticker that is good until the next scheduled test for that vehicle (i.e. 2 years from the initial failure). If the failed vehicle does not pass a retest during the grace period, the vehicle's registration is suspended when the grace period ends. DEP will send a notice to the owner at least one month in advance of the end of the grace period, and again immediately following the suspension, to inform the motorist of the need to repair their vehicle.

The grace period gives drivers time to save funds for emissions repairs, just as they might save for any other major automotive repair. The grace period also gives consumers the option to choose whether to invest in a repair, find alternative means of transportation, sell the vehicle to someone willing to invest in the repairs, or take the polluting vehicle off the road.

Selling the Failed Car. A vehicle with a fail sticker still may be bought and sold during its grace period. The fail sticker will alert prospective buyers, who can decide accordingly what price to pay for the car. After the grace period expires, the car still may be sold, but cannot be re-registered or legally driven until it is repaired and passes the test. DEP will educate the public on the potential liability of buying or selling a failed vehicle.

Emissions Credit Trading. The owner may also choose to sell the failed vehicle to a private business operating a vehicle scrappage program. DEP regulations allow vehicle scrappage to be used to generate tradable emission reduction credits. Businesses may choose to reduce pollution by scrapping failed vehicles, in order to create "credits" for their own use or resale. If private firms show an interest in developing vehicle scrappage programs, DEP will take steps to facilitate such trading.

Quality Control

Achieving significant reductions in air pollution, earning the public's trust in the program, and promoting a level playing field for businesses will all depend upon DEP's ability to ensure a consistent and accurate emissions test. To be successful, the public must believe that the Massachusetts Hybrid will produce the air quality benefits that they are asked to pay for.

As guarantor of the integrity of the program, DEP will institute strong quality controls to achieve this goal. DEP will use both traditional licensing/certification authority and private contractual agreements to enforce the quality standards throughout the testing network. This combined authority will provide DEP with a variety of tools to assess performance and ensure compliance as outlined below.

Automated quality control. Each analyzer will monitor its own condition and automatically prevent further testing if a calibration problem or tampering is detected. Through continuous electronic communication with each emissions analyzer, DEP will be able to monitor testing activity throughout the state. DEP will analyze the data received for irregularities that could indicate fraud or neglect.

Contractual authority. Private franchise agreements in other industries have proven successful at delivering consistent, high quality products. DEP will use a network contractor to establish business relationships with testing stations that will in some ways resemble franchise agreements. These private agreements will provide the contractual authority needed to monitor and correct most test quality problems.

Verification of inspector credentials. DEP will directly verify inspector training and limit access to the registration database to those who are qualified.

Certification of test equipment. DEP will verify that test equipment offered for sale by manufacturers will perform as required. DEP will also ensure that there is competition among multiple equipment manufacturers to provide testing equipment.

Auditing. The credibility of the current emissions testing program has suffered from fraud and negligence, as documented by the DEP Strike Force sting in 1993. Driving a car that had been set to fail the emissions inspection, Strike Force investigators still were able to obtain pass stickers from 85 percent of the stations visited.

In light of the Strike Force findings, DEP will dedicate significant resources to both overt and covert auditing. DEP's primary objective will be to work cooperatively with private testing stations to assist them in correcting problems. When this approach fails or in cases of fraud, DEP will hold testing firms, inspectors, and contractors accountable through compliance monitoring and swift, appropriate enforcement.

Certification authority. DEP will retain primary enforcement authority, conduct administrative hearings on suspending facility certifications, and issue penalties. By 1997, DEP will have launched an improved auditing and enforcement effort for the existing program. This proactive step will help to *reduce* business risk and uncertainty by leveling the playing field. Reputable testing stations will be able to count on DEP to take action against dishonest or incompetent stations and thereby protect honest firms from the unfair business practices of less scrupulous competitors.

Vehicle Maintenance Initiative

Testing alone will not make cars run cleaner or reduce pollution. Test failures must be followed by effective repairs. Emissions control systems, however, are becoming more complex, and the ability to use sophisticated diagnostic equipment is more important each year. The Massachusetts Hybrid addresses the need to help automotive technicians make effective repairs with the Vehicle Maintenance Initiative (VMI).

VMI is a package of features designed to ensure that cars identified as excess polluters are properly repaired. Since only 20% of the vehicles are responsible for 80% of the emissions, the effectiveness of the Massachusetts Hybrid will depend upon its ability to stimulate the competent and successful repair of high-polluting automobiles. VMI will represent a new level of cooperation between DEP and the repair community to ensure the success of the program. The key elements of VMI are:

Diagnostic centers around the state, equipped with up-to-date test and diagnostic equipment. Staffed with expert technicians, the diagnostic centers will assist automotive repair technicians in identifying problems in vehicles that are difficult to troubleshoot. They will also provide on-the-job training, referee inspections for failed vehicles, and support research and program evaluation.

Technical support hotline to provide automotive repair technicians with assistance over the phone for difficult-to-repair vehicles.

Access to information on vehicle repairs performed to correct emission failures. As information is collected by make, model, and year, it will be correlated to failure scenarios and provided to repair technicians to improve the likelihood of accurate repairs.

Certified test stations and emissions inspectors. The emissions test will be performed at certified test stations, by certified emissions inspectors. Inspectors will complete a training course approved by DEP and a group of advisors from the repair industry.

Repair technician registration. As a consumer convenience, drivers who fail the emissions test will be provided a list of businesses employing registered emissions repair technicians in their area. To become registered, repair technicians must pass the ASE L-1 certification or an equivalent training course offered by vocational schools or community colleges. DEP will track the success of these technicians at performing emissions repairs and provide this information to motorists.

Inspection & maintenance newsletter and Internet homepage to answer common questions, notify the industry of program updates, and inform the repair community about diagnostic centers, training opportunities, and the hotline. The newsletter will also serve as a forum for recognizing outstanding technicians and promoting pride in the profession.

Diesel Cars, Trucks & Buses

Although fewer in number than gasoline powered vehicles, diesel-powered cars, trucks, and buses are a very visible part of the air pollution problem on Massachusetts roadways. Trucks and buses contribute approximately 12% of the ozone-forming pollution in the Commonwealth, about half as much as passenger cars. They also produce significant amounts of small dust particles (particulate matter), some of which we see as black diesel smoke.

At present, diesels are not required to be tested for emissions. The Massachusetts Hybrid, however, will start testing diesels and taking other steps to lower pollution from diesel cars, trucks, and buses. These measures could include:

- random roadside inspections of heavy-duty vehicles at weigh stations and other locations such as refueling centers using a smoke opacity test certified by the Society of Automotive Engineers (SAE).
- biennial testing of diesel cars and trucks (up to 26,000 pounds) using the SAE test.
- a tax incentive for converting diesel engines to cleaner fuels, such as compressed natural gas, and retrofitting diesel engines to meet stricter pollution standards.
- encouraging the use of clean-burning fuels in diesel vehicles.

Such a mix of incentives and testing will ensure that the burden of cleaner air is also shared by diesels. DEP will begin exploring these possibilities with interested parties during the program phase-in.

Public Communications Plan

Public support for the Massachusetts Hybrid is vital to its success. States that have launched an emissions program without adequate communications have encountered problems with public acceptance. A proactive communications plan has been designed to keep the public involved throughout the development and implementation of the Massachusetts Hybrid. Implementation of this plan will begin in 1996.

The Massachusetts Hybrid will ask consumers to change behavior in both the inspection and maintenance of their vehicles. People, generally, do not change behavior because they are told to; they need to discover good reasons why change will be beneficial for them.

To facilitate this transition, the communications plan will present the Massachusetts Hybrid to consumers as an opportunity to directly improve air quality. Over a three-year period, the program will help consumers understand the nature of air quality and its effect on public health, the sources of air pollution, opportunities for pollution prevention, and the benefits of the Massachusetts Hybrid. The plan will include two-way communication through face-to-face meetings, forums, and exhibits, to help people question, understand, and assimilate the information. In addition, standard one-way communication methods (such as direct mail, public service advertising, brochures, media coverage, etc.) will be used to reinforce the messages.

The message strategy is designed to encourage consumers to support the program because they understand the issues, costs, and benefits *before* they are asked to change their behavior. The communications program will be implemented in three distinct waves over three years:

Wave I (1996-1997)

Develops context with a broad education campaign about air quality. Wave I issues will include the components of air pollution, how air quality affects public (and personal) health, relative sources of air pollution, existing air quality programs, and opportunities to reduce air pollution.

Wave II (1997-1998)

Links cars to air quality and prepares the public for the new program. Wave II will focus on the role of cars in air pollution, the need for an inspection program, features and benefits of the new program, the importance of repair and maintenance, and how DEP will monitor and report results.

Wave III (1998-1999)

Focuses on specific program features as biennial dynamometer testing of the full fleet approaches. Wave III messages will include where, when, and how to get inspected; the notification process; DEP's role in ensuring honest tests and repairs; and motorists' options in the event of a failure. DEP will routinely give updates to the public on testing results and air quality improvements.

A team of stakeholders, representing a broad range of interests, will be spokespersons for the program. The team will be drawn from business, environmental groups, public health, consumers, and the repair industry, and will be actively involved in the program as advisors. They will be trained to meet with editorial boards, appear on public affairs and feature broadcasts, and meet with opinion leaders and the public. The team will represent a highly credible source, be balanced across interests, and ensure consistency in strategy and message.

Three segments of the public are key to the success of the program: opinion leaders, the general public, and the auto repair industry. The messages, choice of media, and materials will be tailored to reflect the interests of each audience. For example:

- To engage opinion leaders whose credibility and visibility can influence their constituents, the plan will focus on two-way communications including: an executive level speaker's bureau to place spokespersons before senior industry, trade and consumer groups; meetings with editorial boards; and meetings with major employers and fleet owners. One-way communications will focus on media relations with the business press (meetings, opinion pieces, letters to the editor, guest columns); media relations with trade publications; and direct mail to fleet managers.

- To engage the public, the plan balances and reinforces different approaches. Two-way outreach will include sending speakers to local organizations, staffed booths at public events including displays and interactive exhibits, appearances on news and feature talk shows (TV and radio), demonstrations at environmental and/or automotive events, and on-line forums. One-way outreach will include a multi-media public service campaign; media relations to generate news and feature articles in newspapers; direct mail; and distribution of brochures, posters, fact sheets, and announcements.

- To engage the automotive repair industry, the plan will include: meetings with trade associations, technical speeches at industry events and trade shows, information booths at shows/meetings, and frequent meetings with the heads of trade associations. One-way outreach will include periodic letters from the Commissioner, a newsletter, and an information hotline, as well as the Vehicle Maintenance Initiative.

In summary, the communications plan is designed to build broad-based public support for, and participation in, the Massachusetts Hybrid. It will inform, involve and motivate the public; reinforce the messages through a mix of outreach activities; and give grass roots credibility to the program through a team of spokespersons providing accurate information that addresses a wide range of stakeholders' questions and concerns.

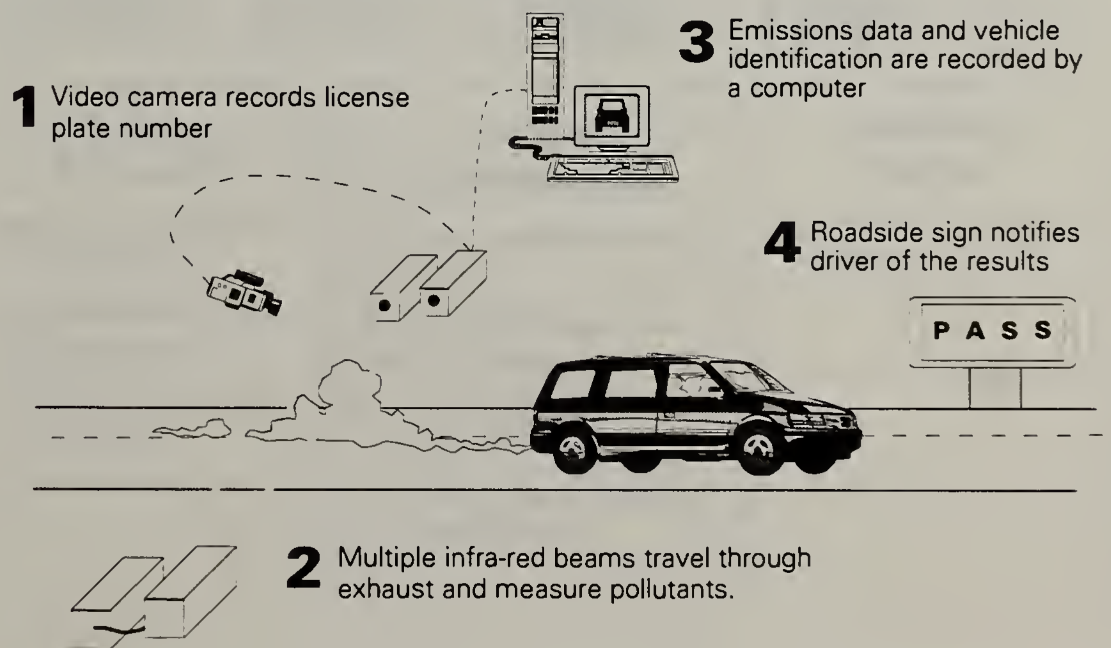
Clean Screen Pilot Study

A unique feature of the Massachusetts Hybrid is the "clean screen" pilot study proposed for Berkshire County. The study will determine whether remote sensing can be used to identify clean cars while they are on the road, as a supplement to the standard emissions test. Although other states are testing remote sensing as a means of failing cars, the use of remote sensing to "clean screen" vehicles would be unique in the United States.

Remote sensing is an emerging technology that detects exhaust gases from the tailpipe by shining a beam of infrared light through the vehicle's exhaust. This beam is then absorbed by the different gases in the exhaust, and the concentrations of the gases are calculated based on how much of the infrared light is absorbed. The measurement is performed in a fraction of a second, but multiple measurements are required for accuracy. Although research into the practical use of this technology has just begun, recent data from Canada suggests that about one quarter of all vehicles might pass a clean screen test.

The clean screen will offer motorists in Berkshire County the opportunity to voluntarily drive by arrays of remote sensors. To make the clean screen convenient, these sensors will be located in high traffic areas such as shopping centers or highway rest stops, and results will be made available to drivers on the spot. If a car passes, then it will be exempted from the standard emissions test for two years, and DEP will send the owner a "pass" sticker in the mail. The pilot study

Remote Sensing


1 Video camera records license plate number
3 Emissions data and vehicle identification are recorded by a computer
4 Roadside sign notifies driver of the results
PASS
2 Multiple infra-red beams travel through exhaust and measure pollutants.

will first determine the potential accuracy of remote sensing equipment under field conditions, and then pilot the clean screen concept with Berkshire motorists.

While the clean screen concept is promising, remote sensing is still experimental technology. There are limitations in the accuracy and efficiency of existing remote sensors, and they will still falsely pass a percentage of high-polluting vehicles even under the best of conditions. The pilot study will be the first step in determining whether remote sensing is a practical means of achieving cleaner air with less cost and inconvenience for motorists.

Three-Year Phase-In

A key feature of the Massachusetts Hybrid is a gradual, well-planned program implementation. Other states have experienced serious problems attempting to roll out new programs under short deadlines. To avoid these problems the Massachusetts Hybrid will be phased-in over a three-year period. Routine biennial dynamometer testing will begin in 1999.

The phase-in will transform the outdated inefficient idle test into a modern inspection program with minimal disruption to consumers or the repair industry. The three-year phase-in will have several significant benefits:

- It will afford DEP an opportunity to test and debug the automated communication network and dynamometers before the start of routine testing.

1996 | 1997 | 1998 | 1999 ⇨

Design & Training

- Begin public education and technician training.
- Issue specifications for new testing equipment.
- Establish electronic communication network.
- Hire network contractor.

Systems Implementation

- Require new analyzers for all test stations
- Collect data to demonstrate program effectiveness.
- Begin testing large private fleets and state cars on dynamometers.
- Start field testing remote sensing in Berkshire County.

Full Fleet Testing

- Routine biennial dynamometer testing.

- It will allow time to develop and perfect a comprehensive quality control program.
- It will enable technicians to become thoroughly familiar with the new equipment and data systems.

The implementation will have three phases: (1) design & training, (2) systems implementation, and (3) full fleet testing. The schedule assumes that enabling legislation will be enacted in 1996. Significant features of the implementation plan are highlighted in the following paragraphs.

Features

Full integration with recent federal legislation. The schedule proposed here makes use of the opportunity that Congress has granted to states developing emissions testing programs. In November, 1995, Congress passed legislation authorizing states to propose decentralized testing networks without automatic penalties. The legislation allows interim approval for such networks while states demonstrate their effectiveness. The Massachusetts Hybrid will use 1997 data to demonstrate that the network can eliminate improper testing.

Early introduction of new analytical equipment. One of DEP's first tasks will be to allow test centers to upgrade their old equipment to new five-gas analyzers. The new analyzers will be used for both the existing idle test and for the successor dynamometer test. DEP plans to release specifications for the entire equipment suite (analyzers, computers, and dynamometers) in 1996. Dynamometers will not be required at this time. Although able to perform the idle test, these new analyzers will have all of the security, communications, and quality control features needed for a modern dynamometer test. All stations intending to participate in the successor program will be required to have the new analyzer and computer equipment by July, 1997. Evaporative and two-speed idle testing will also be incorporated into the program at that time.

Early introduction of repair technician training. To ensure that repair technicians are ready to diagnose and remedy the emissions failures that will be detected by dynamometers, DEP will make technician training an early priority. Beginning in 1996, DEP will help community colleges and other training institutions develop a comprehensive emissions repair curriculum. The goal will be to make this training available to technicians in early 1997.

Early demonstration of network effectiveness. Once the new analyzers are installed in 1997, they will allow DEP to automate quality control. DEP will then start an aggressive data collection program to demonstrate the decentralized network's effectiveness at providing accurate inspections. This will allow

DEP to assess problems in the network and fix them before dynamometers are installed.

Close coordination with repair, training, and test equipment industries. From the earliest stages of program development, DEP will pursue a close working relationship with private sector partners including repair shops, technician training providers (including community colleges), and the manufacturers of emissions testing equipment. Rather than simply communicate the program's progress, DEP will actively solicit the private sector's recommendations for making the Massachusetts Hybrid more effective and efficient.

Voluntary initiation of the dynamometer test. Test stations may be offered the choice of purchasing new equipment and starting dynamometer testing early if they believe it will be a good business decision. Stations that choose an early start may offer their customers the option of either the standard one-year sticker for an idle test at the current fee, or a two-year sticker for the dynamometer test at a higher fee. During the phase-in period, if a car fails the dynamometer test, it will still be allowed to obtain a one-year sticker if it can pass the two-speed idle test.

Phase-in of test standards. DEP will use the same emissions cutpoints as other states to achieve the state's air quality goals. These cutpoints, however, can be varied by DEP to balance air quality goals with the potential burden of repairs on the public and the repair industry. Initially, the cutpoints will be somewhat lower than those required to meet DEP's air quality objectives. After this phase-in period, however, the cutpoints will be tightened so that during the life of the program DEP's pollution reduction goals will be reached.

A failure rate of 15-20% is anticipated for the first year of biennial dynamometer testing. Although the standards will be tightened over time, failure rates may not actually rise due to the durability of previous repairs and improvements in the reliability of emissions control systems. DEP will constantly monitor the test results, and maintain the flexibility to make timely adjustments should the results warrant a change.

Schedule

A schedule of the key steps that will be taken to implement the Massachusetts Hybrid is proposed on the following page.

Schedule

for the Massachusetts Hybrid

Design & Training: Spring 1996 to Early 1997

- ☑ Begin regular communication with the repair community through meetings and a newsletter.
- ☑ Begin educating motorists about the relationship between health, cleaner air, and the new test program.
- ☑ Issue specifications for new test equipment, test procedures, inspector training, and communication protocols.
- ☑ Allow the new analyzers to be used for both the existing idle test and the new dynamometer test.
- ☑ Complete the technician training curriculum, with courses offered in Spring 1997.
- ☑ Begin auditing and enforcement program for all testing stations to refine quality assurance procedures.
- ☑ Design Berkshire remote sensing pilot.
- ☑ Select network management contractor.
- ☑ Allow stations to perform dynamometer tests on a voluntary basis.
- ☑ Establish electronic data link between DEP and the inspection stations using the new equipment.

System Implementation: Mid 1997 and 1998

- ☑ Start field testing remote sensing in Berkshire County.
- ☑ Require purchase of new analytical and communications equipment for those stations intending to be part of the successor program.
- ☑ Begin automated quality control.
- ☑ Open diagnostic test centers.
- ☑ Collect data to verify effectiveness of the program according to recent federal legislation.
- ☑ Begin testing fleets on dynamometers.
- ☑ Establish technician hotline.

Full Fleet Testing: Early 1999

- ☑ Commence routine dynamometer testing of all cars and small trucks.
- ☑ Switch to testing vehicles once every two years.

Although 1999 will mark completion of the phase-in period, it will not signal the end of DEP's efforts to improve the program. Following the start of routine dynamometer testing, DEP will continue to refine the Massachusetts Hybrid through research on new technology such as On-Board Diagnostics (OBD), High Emitter Profiles (HEP), alternative fuels, and remote sensing. DEP's goal in conducting this research will be to make sure that the benefits of advancing technology will be available to provide cleaner air with less burden on the State's motorists. By planning for improvement in advance, DEP will create a dynamic program that can be responsive to the changing needs of motorists, technicians, and the environment.

Questions & Answers

Q&A

Questions and Answers
on the Massachusetts Hybrid
Vehicle Inspection and Maintenance
Program Proposal

March 1996

Do we need to reduce air pollution further?

Yes. Massachusetts does not currently meet the federal standard for ground-level ozone: Ozone (O_3) is a compound formed when oxides of nitrogen (NO_x) combine with hydrocarbons and sunlight. Ozone is harmful to both humans and plants. Massachusetts regularly exceeds the federal standard for ground-level ozone of 120 parts per billion (ppb), which has caused the state to be designated a "serious nonattainment area." The Clean Air Act requires the state to take steps to meet the federal standard by 1999. Since cars are the single largest source of ozone-forming pollution, a vehicle emissions inspection program is an effective tool to help us keep moving toward clean air.

We need to keep moving toward clean air to protect public health: Every summer, DEP regularly issues health advisories warning children, the elderly, people with respiratory diseases like asthma, and other "sensitive populations" to limit their physical exercise and stay indoors.

The number of " bad air" days each summer varies over the years due to the weather. In Summer 1995 Massachusetts had 17 health advisory days.. During long hot summers, such as the Summer of 1988, there are many more "bad air" days.

Evidence is emerging that our federal standard may not be sufficient: The current standard may not adequately protect even healthy people from air pollution. There is significant research indicating that "bad air" days, when ozone levels rise to meet and exceed the federal standard, affect the health of all people, even those who are not usually considered "sensitive." Data also suggest that normal lung function is impaired at levels much lower than our existing standard.

6/4/96
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Health scientists and researchers at the Harvard School of Public Health, the National Center for Environmental Health at the CDC, and the National Association of Physicians for the Environment, have concluded that our existing ozone standard of 120 ppb may not be sufficient to protect public health. Researchers concluded that ground-level ozone adversely affects asthmatics at levels *well* below the current U. S. standard.

Other countries have more stringent standards for ground level ozone:

In 1995 Massachusetts had over 21 days during June, July, and August when the air pollution levels did not meet the standards set by other countries such as Canada, Germany and Japan.

- Canada, Germany, and Japan have ground level ozone standards below the current U.S. standard.
- Massachusetts does not meet the emission standards established by Canada, Germany and Japan.

Other Countries' Standards	
U.S. Standard	120 ppb
Canada	80 ppb
European Community - 1 hour	90 ppb
European Community - 8 hour	60 ppb
Japan - 1 hour	60 ppb

Do cars really create that much pollution?

Yes. Motor vehicles create a significant amount of air pollution. Cars and trucks together contribute over one third of ozone-causing pollution in the Commonwealth. In addition to ozone-causing pollution, cars and trucks also emit toxic compounds into the atmosphere.

Industry and business have made significant improvements in reducing pollution, so much so that cars are now responsible for more smog-forming pollution than any other single source. Although new cars are designed to pollute less than older cars, lack of maintenance and normal deterioration of the emission control system cause cars to produce more pollution as they get older.

Massachusetts motorists are driving more now, too. Comparing 1983 to 1993, we see:

- the number of licensed drivers in the Commonwealth increased over 12% and
- the average number of miles driven per year per car increased 15%.

So even though today's new cars are cleaner, they still deteriorate and pollute over time, there are more of them on the road, and we drive them more miles.

Isn't the current idle test good enough?

No. The idle test doesn't work on today's modern vehicles for two reasons.

1. An idle test can miss problems in modern fuel-injected, computer-controlled vehicles. Since the early 1980s car manufacturers have used computer chips and feedback sensors to regulate the flow of air and fuel into vehicle engines. These computers precisely adjust the air-to-fuel ratio in response to changes in the car's engine temperature, speed, load, and other factors. When these systems work properly, the car produces less pollution.

The problem for our current idle test is that the on-board computer tells a modern car to run very differently on the road than it does at idle. The idle test cannot simulate real driving conditions for these cars, and so will to pass many dirty cars. To effectively test modern vehicles, we need to simulate normal driving conditions on a dynamometer which varies the speed of the vehicle.

2. Idle tests cannot measure oxides of nitrogen (NO_x). Measuring NO_x is crucial because NO_x is a prime cause of our serious summertime ground-level ozone pollution. NO_x combines with hydrocarbons (also produced by cars) and sunlight to form **ozone** (O_3), a compound that is harmful to both humans and plants.

To reduce ground-level ozone levels, we need to reduce the amount of both NO_x and hydrocarbons. The problem with the idle test is that very little NO_x is produced by cars at idle even though the same cars could be excessive NO_x emitters at normal road speeds. Therefore the idle test cannot effectively measure NO_x. To compound the problem, repairs made to reduce hydrocarbon pollution at idle can actually make NO_x problems worse. Without the ability to measure NO_x, repairs made to pass an idle test could result in a car becoming a gross emitter of NO_x.

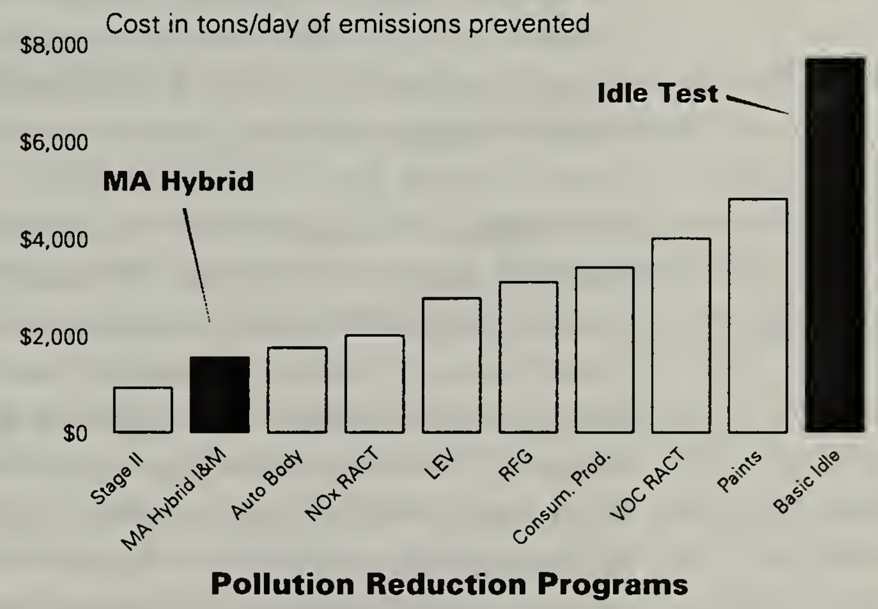
Choosing NOT to reduce NO_x from cars would leave industry as the primary source from which reductions in NO_x emissions could be obtained. The Commonwealth needs a shared solution that reduces NO_x from ALL major sources, including vehicles.

Is vehicle inspection & maintenance cost-effective?

Yes. Vehicle inspection programs using dynamometers are among the most cost-effective of all our air pollution control strategies. The Massachusetts Hybrid will prevent approximately 67 tons of volatile organic compounds (VOCs) and 93 tons of oxides of nitrogen (NO_x) from entering the air **PER DAY** at a cost of approximately $1500 per ton.

Inspection programs using an idle test are much less cost effective, and would cost approximately $7,600 per ton as shown in the following graph. The difference in cost effectiveness between a dynamometer test and an idle test becomes even greater when oxides of nitrogen (NO_x) are considered, because the idle test cannot measure NO_x. This deficiency means that any NO_x reductions achieved by an idle test are produced by chance, and therefore very expensive.

Cost of Pollution Controls



Glossary of Pollution Controls

Stage II is a requirement for vapor controls on gasoline pumps.

Auto Body shops are required to use cleaner paints and more efficient application methods.

LEVs are Low Emission Vehicles. Cars and trucks sold in Massachusetts after 1995 must meet California LEV standards.

RFG stands for ReFormulated Gasoline (cleaner gasoline).

Consum. Prod. are consumer products such as air fresheners, degreasers, polishes, glass cleaners, and insecticides that must be reformulated to reduce volatile organic compounds.

VOC/NO_x RACT requires industries to use Reasonably Available Control Technologies to control hydrocarbon and NO_x pollution.

Paints (also includes stains, an roof coatings) that are required to be cleaner through reformulation to water-based or low-VOC solvents.

Did DEP consider other options?

Yes. In developing the Massachusetts Hybrid, DEP considered many different types of vehicle inspection and maintenance (I&M) programs, including a no program option. The major options are listed below, along with some of their strengths and weaknesses.

No Program. Eliminating I&M would mean that DEP either would have to allow air quality to deteriorate, in violation of the Clean Air Act, or would have to place much stricter, increasingly costly controls on industry and consumer products. Industry and utilities have already made significant efforts to reduce air pollution and will continue to apply tighter controls in the future. Obtaining further reductions in pollution from industry and utility sources will be expensive. Vehicle inspection and maintenance is more cost effective than additional controls on industry. Therefore, vehicle I&M is the most reasonable means to achieve cleaner air, allow for continued business growth, and meet the Federal ozone standard.

Continue or Improve Existing Basic Idle Test. Although convenient, the basic idle test is substantially less effective at measuring hydrocarbons in modern computer-controlled vehicles, and cannot be used to measure NO_x at all. In addition, the current program is widely known to be fraudulent. These limitations make the existing idle test the most expensive pollution reduction strategy. DEP recommends replacing this inefficient, and fraud-ridden program.

Centralized Test-Only I&M. This option was EPA's original I&M network plan under the Clean Air Act. This option would take testing out of repair garages and establish a network of specialized test-only facilities. Centralized test-only facilities with dynamometers are the most cost-effective program and easiest to control for fraud. They gain their efficiency through high volume and economies of scale. They are, however, less convenient to the public because there are fewer stations and vehicles cannot be repaired at the same location. Many states that tried to implement this plan ran into serious difficulties and halted their programs. The Weld/Celluci Administration placed this option on hold in Massachusetts in February, 1995.

Decentralized Test-Only I&M. This option is more convenient than EPA's centralized model because more facilities would be built. Because this option does not allow repairs to be performed at testing locations, the incentive for fraud is still relatively low. The larger number of stations, however, would raise the cost of the tests and make quality control more difficult than in a centralized network. The increase in cost would be determined by the number of stations – the larger the number, the higher the cost.

Decentralized Test & Repair. This option places dynamometer testing equipment in repair garages. The number of test locations would be smaller than the number of locations that exist today due to the cost of the equipment, but still convenient to the average motorist. Test integrity could be compromised due to the inherent conflict of interest caused by allowing repair stations to perform emissions tests. Extensive auditing would be required to guard against fraud.

Test-Only with Repair & Retest. This option would require initial tests to be performed in a test-only station, but allows failing cars to be retested at the garage where they are repaired. This option fits better in states that already have a network of both state-run test-only facilities and privately-run test-and-repair garages, and is relatively complex for states which don't. Again, retest integrity could be compromised due to the inherent conflict of interest caused by allowing repairers to perform emissions tests. The cost of this option would be relatively high due to the duplication of equipment in the repair stations.

Massachusetts Hybrid. The proposed hybrid combines the decentralized test-and-repair and decentralized test-only models to strike a reasonable balance between the faults and benefits of all of the options considered. To improve efficiency and convenience the network will include both high-volume and low-volume stations, depending upon the local market. Consumers will have the choice of going to either a test-only station, or one that also performs repairs. A network contractor will be responsible for providing adequate geographic coverage and would use franchise-like private agreements to ensure the reliability of the test. Because all stations would use dynamometer testing, air pollution reductions will approach those of the pure test-only model, and will be highly cost-effective.

Can remote sensing replace a dynamometer test?

No. Remote sensing has been suggested as a replacement for dynamometer-based emissions tests. The appeal of this approach is that only those vehicles that are gross polluters would be subject to a garage-based inspection, while the vast majority of clean vehicles could forgo the garage-based inspection entirely. Results from field studies, however, indicate that remote sensing technology, as it exists today, lacks the necessary accuracy and efficiency to form the basis of a vehicle testing program.

Accuracy. Remote sensing works by shining a beam of infrared light through a vehicle's exhaust as it passes by on the road. The remote sensors calculate the concentration of gases in the exhaust by measuring the intensity of the light that passes through the exhaust plume. This system has three inherent qualities that limit its accuracy when compared to a garage-based dynamometer emissions test.

First, a remote sensor can take only a single "snapshot" of pollution from a vehicle at one speed and under one load condition (i.e., cruising, accelerating, or decelerating). This snapshot does not reveal how the vehicle performs over a range of speeds and loads. Even several remote sensing measurements taken together can only represent a limited range of performance. This constraint causes remote sensing to fail many clean cars while passing many dirty cars. A dynamometer test, however, can vary speeds and loads to simulate a wide range of driving situations, and thereby give a much more accurate view of a vehicle's emissions.

Second, remote sensing is not capable of measuring the actual quantity of pollution coming from a vehicle. Instead it can only measure exhaust gas concentrations, a limitation it shares with the idle test. Measuring concentrations alone fails to account for differences in vehicle engine size and fuel economy. This need to estimate actual emissions from concentration-based readings is another source of inaccuracy inherent in today's remote sensing technology.

Third, remote sensing cannot measure evaporative emissions. Evaporative emissions are pollution that comes from leaking or malfunctioning fuel systems. Evaporative emissions represent about 25% of a vehicle's total emissions. Testing for evaporative emissions is an integral part of the Massachusetts Hybrid.

Because of these inaccuracies inherent in the technology, remote sensing cannot be the primary basis for an emissions test program. A dynamometer test is still needed to confirm remote sensing failures and to prevent repairs to clean vehicles that were miss-identified as dirty. Thus, a network of dynamometer-based testing stations would still be required in a remote sensing system.

Other practical limitations. Remote sensors cannot operate in rain or snow. Remote sensors generally operate on-one lane roads (e.g., expressway ramps) because the sensors can only take readings from one vehicle lane at a time. Obtaining measurements on all vehicles in a given area is difficult because remote sensors can only test those vehicles that happen to drive by the location where a remote sensing van is stationed. Remote sensors also require multiple measurements on each vehicle, and about 25%-50% of all readings are invalid even under good conditions. The combination of these limitations might mean that a remote sensing system would fail to test a large portion of the fleet, or that the expense required to test the entire fleet would be prohibitive.

Remote sensing studies. Real world tests of remote sensing have not been successful in identifying high polluting vehicles. In 1995, California and EPA conducted the largest pilot test of remote sensing to date. In that study, remote sensors were able to find only 10% of the pollution problem in the cars that were tested even though the pass/fail cut points were set so high that over half of the cars that failed were actually clean. For comparison, the Massachusetts Hybrid's dynamometer and evaporative tests are designed to identify over 90% of the pollution problem in our fleet.

Cost effectiveness. Since remote sensing (1) tends to fail a large number of clean vehicles (i.e., has a high rate of false failures), (2) is unable to identify evaporative emissions failures, (3) requires multiple tests at different locations, (4) would have practical difficulty covering the entire fleet, and (5) still needs a dynamometer-based test network to confirm results, a remote sensing emissions test system would likely have a high cost relative to its ability to reduce pollution.

Diagnostic information for repairs. Since remote sensing only takes a snapshot of a vehicle's emissions, remote sensing results provide repair technicians with very little information that will help them fix a failed vehicle. A dynamometer trace, however, gives the technician a clear view of where a vehicle is having problems and where it is running clean, making diagnosis and repair more efficient and effective.

Use of remote sensing by other states. No state has designed, or is designing, an inspection program using remote sensing as the primary test. Instead, many states (e.g., Arizona, Colorado, Florida, California, and New Jersey) are using or planning to use remote sensing as a supplement to a dynamometer-based emissions test. In these states remote sensing will be used for research, for identifying vehicles that are more likely than others to have emissions problems, and as a supplemental enforcement tool.

Will remote sensing work as a "clean screen"?

Maybe. Although many studies have been performed with remote sensing equipment, there is no general agreement about its effectiveness. Whether remote sensing is useful may depend on whether it is employed to fail the dirtiest cars, or to screen out the cleanest cars.

Most remote sensing studies concentrate on identifying dirty, high polluting vehicles. DEP, however, will examine the use of remote sensing to screen out the cleanest cars, and exempt them from the regular emissions test. Ontario, Canada, has piloted such a clean screen test which runs cars past an array of remote sensors under controlled conditions. Ontario showed that if 30% of the fleet were exempted from the standard emissions test by the clean screen, then there would be a increase in pollution of about 3% overall (i.e., a 10% reduction in the effectiveness of the inspection and maintenance program). The reason for this lost effectiveness is that remote sensing falsely passes some percentage of high polluting vehicles even under the best of conditions. These vehicles then continue to pollute excessively, thereby decreasing the overall ability of the program to reduce pollution. In the Ontario study, part of this problem was caused by taking only low-speed remote sensing measurements. This allowed vehicles that were gross polluters at high speeds to get by the remote sensors undetected, and reduce the effectiveness of the program.

In spite of its current limitations, remote sensing technology is worth further investigation because of its tremendous potential for saving both time and money. The Berkshire County pilot study will take Ontario's clean screen approach and test it under both controlled and on-road (i.e. high-speed) conditions. With the benefit of further advances in technology and experience from other states, DEP may be able to obtain somewhat better results than previous remote sensing studies.

Does the Massachusetts Hybrid comply with the Clean Air Act?

Yes. The Clean Air Act Amendments (CAA) of 1990 classified areas of the country by the severity of their air quality problems, and required air pollution controls commensurate with observed pollution levels. Massachusetts has been designated a "**serious nonattainment area**" for ground-level ozone because air monitoring data show that the Commonwealth is not in compliance with the national ambient air quality standard. That standard is 120 parts per billion (ppb) averaged over one hour. This ozone standard is health-based, and was designed to protect the most sensitive populations, such as asthmatics, children, and the elderly, from the effects of pollution.

The CAA requires that each state not meeting national ambient air quality standards develop and submit state implementation plans (SIPs) to bring the region into attainment by a prescribed date. For Massachusetts this date is November 15, 1999.

The CAA requires two milestone reductions in pollution:

1. A demonstration of "reasonable further progress" (RFP) toward achieving the standard which, at a minimum, includes a 15% reduction in volatile organic compound (VOC) emissions by 1996, and
2. From 1996 to 1999, a 3% per year reduction of VOC and/or oxides of nitrogen (NOx) emissions.

The CAA also requires the state to implement an "enhanced" vehicle emissions inspection and maintenance program as part of the effort to achieve the standard.

The Massachusetts SIP incorporates a wide range of strategies to reduce air pollution including reformulated gasoline, low emission vehicles, industrial pollution controls, gasoline vapor control, requirements for cleaner paints and finishes, and the automobile emission inspection and maintenance (I&M) program. The I&M program is a key component of the Massachusetts SIP because it accounts for a substantial portion of the required air pollution reductions.

Air pollution modeling shows that the minimum requirements of the CAA (15% and 9% milestones) will not be sufficient to attain the ozone standard by 1999. As a result, the Commonwealth needs to implement more than the minimum CAA requirements to reach attainment. Also, Massachusetts needs to submit an air quality maintenance plan to ensure maintenance of the standard for two 10-year periods following attainment.

CAA Requirements for I&M

The CAA specifies that EPA establish guidance on enhanced I&M program design. EPA's requirements for I&M include:

1. A test-only centralized emissions testing network, unless a state can demonstrate that an alternative program design will achieve equivalent emission reductions.
2. The use of on-road emissions testing (remote sensing or road-side pullovers) for enforcement.
3. Annual emissions testing, unless a biennial inspection along with other program features will result in equivalent or greater emission reductions.
4. Enforcement through the denial of vehicle registration.

The Commonwealth responded to the CAA requirements with the creation of a special legislative study commission, whose mandate included devising new enabling legislation for the enhanced emissions inspection program. In August 1993, the Special Legislative Commission on Vehicle Inspection and Maintenance recommended that Massachusetts design an I&M program that incorporated EPA requirements.

New Flexibility

Recently passed federal legislation makes it possible to develop a hybrid vehicle inspection and maintenance program that differs from the original EPA recommendations, but still achieves significant emission reductions. As a result, EPA may allow significant pollution reduction credit for programs that are based on an "enhanced" decentralized test-and-repair network instead of the original centralized test-only model. EPA will not automatically discount the effectiveness of a decentralized test and repair I&M program as it had in the past. States will be required to provide EPA with sufficient data that shows that a hybrid program can achieve equivalent emissions reductions.

DEP believes that the Massachusetts Hybrid can meet the requirements for enhanced inspection and maintenance programs. DEP will collect sufficient data to demonstrate that the Massachusetts Hybrid deserves maximum credit for reducing air pollution. This credit will be based on the use of dynamometers, strong quality assurance and quality control features, and repair technician training.

Shouldn't trucks and buses also be tested?

Yes. Diesel trucks and buses are a very visible part of the air pollution problem on Massachusetts's roadways. Heavy-duty diesel engines emit the following types of pollution:

- the black smoke we can see,
- invisible, fine particulates (PM) that can cause damage to the lungs,
- oxides of nitrogen (NOx), hydrocarbons (HC), and carbon monoxide (CO) (also produced by cars), and
- other toxic air contaminants.

Smoke

A smoke opacity meter is a portable device that measures the amount of smoke in the diesel exhaust plume. Several states use this device for testing. California will perform roadside testing of heavy-duty diesels beginning in 1996, and Arizona currently tests state-registered heavy-duty diesels by this method at centralized test centers. The Massachusetts Hybrid will explore the use of smoke opacity meters or remote sensing devices to identify smoking diesels.

Urban Bus Retrofits

All 1993 or earlier model year urban bus engines, when rebuilt or replaced, must meet standards for reduced emissions of particulate matter. This standard applies in cities with populations of 750,000 or more. It will ensure that diesels, which may remain on the road for 20 years or more, are as clean as possible during their lifetimes.

Diesels in the Massachusetts Hybrid

DEP plans to require smoke opacity tests on heavy-duty trucks at weigh stations or other locations such as refueling centers. The test will be based on the Society of Automotive Engineers (SAE) J1667 test procedure, which is supported by the trucking industry. If a vehicle fails the test, notification will be given to the registered party to fix and repair the malfunction. DEP will also promote the conversion of diesel engines to cleaner-burning fuels, such as compressed natural gas (CNG), by sponsoring legislation which will allow the trucking industry tax credits for engine conversions.

Will a Failed Car Have to be Repaired?

Yes. Most cars that fail will be repaired promptly, will pass the reinspection, and will receive an emissions sticker.

However, there will be a small number of cars that will be difficult to fix, or so poorly maintained that extensive work would be needed to fix these emissions problem. In addition, some owners of failed cars will have a difficult time affording emissions repairs, and others will perceive that the repairs are too expensive.

In response to these issues, DEP has evaluated a range of options to address the cost of repairing emissions failures. Each of these options has a different way of providing financial relief for cars owners whose repairs are too expensive while ensuring that polluting cars are either fixed or taken off the road.

Cost Waiver. One option is a Cost Waiver, in which consumers that spends a minimum amount on qualifying repairs may receive an emissions sticker at retest even if the car doesn't pass the emissions test . That minimum amount is usually set fairly high, to ensure that some reduction in pollution occurs (for example, EPA uses $450). If a car passes when it is retested, it gets a sticker. If it fails, and the owner has spent at least that amount for repairs, the car likewise gets a sticker.

The strengths of this approach are that 1) it caps the amount that any consumer will have to spend for emissions repairs; and 2) repairs that qualify for the cost waiver will yield some reduction in pollution. The drawbacks are that it requires government rules and regulations to define and approve "qualifying" repairs, and that it allows these cars to continue producing excess pollution. In states where this program is used, there is the perception that it tends to favor owners with sufficient funds (who can spend enough to get the waiver), and disadvantages those without (who may not have the minimum amount).

Hardship Waiver. A second option is a Hardship Waiver, which would be granted based on the economic status of the owner. Some measure of economic hardship is applied (e.g., income level), and a sticker is issued for the car if the owner qualifies.

A benefit of this approach is that it affords relief to poorest working families who need a car for transportation and who cannot afford repairs. However, it allows these failing cars to continue polluting without any repairs that reduce pollution, and requires an additional program to administer a means test. (A Cost Waiver for participants in this program can be added to ensure that a modest amount of repairs are made on all cars.) This option is consistent with a public perception that all polluting cars should be repaired, and that an exception can be made for those that can't afford repairs and need the car for work.

Grace Period. A third option is the Grace Period. In this option, the owner of a failed car may continue driving the car for a certain amount of time. By the end of that period, the car must either pass the emissions test or the owner must take the car off the road. Incentives to encourage owners to repair and retest promptly can be added.

This option encourages owners to treat emissions repairs as they do all other car repairs. They will either repair the car promptly, will drive the car while saving for repairs, or will sell the car and buy another. When a car reaches the end of the grace period, it is either repaired so that it passes the reinspection, or the car's registration is suspended so that it cannot be legally driven on the road.

An advantage to this approach is that it ensures that all cars must eventually pass the emissions test or be taken off the road. This reduces pollution, while providing a way for owners to save money if the repairs are more expensive. To the extent that the grace period is long (1-2 years), or that a significant number of owners delay repairs, this option is less effective at reducing pollution. A shorter grace period (3-6 months), or a grace period that decreases over the years will make this option more effective.

Partial Repair Waiver. A fourth option is the Partial Repair Waiver. Cars that fail the test would receive stickers at retest as long as significant pollution reductions are made. This system rewards incremental reductions in pollution, and is similar to the intent of the Cost Waiver. Because it would create two standards for issuing emissions stickers, one for cars to pass and another for cars that have failed, it may be perceived as inequitable.

Preferred Option. The Department favors a grace period as being more equitable, easily understood, and potentially more effective than any other one option. It maintains a consistent environmental position regarding polluting cars, yet provides some reasonable time period for people to fix their cars. It also avoids establishing an additional administrative program to evaluate drivers' income levels or qualifying repairs. A Cost Waiver can be added to this option if additional financial relief is needed.

Q&A

What tests are other states using?

Comparison of Selected State Enhanced I & M Programs -- January 1996

	ARIZONA	CALIFORNIA	COLORADO	CONNECTICUT	GEORGIA
Program Status	Program implemented	Law passed	Law passed	Law passed	Law passed
Start/Completion of 1st Enhanced Inspection Period	January, 1995 → January, 1997	January, 1996 → January, 1998	January, 1995 → December, 1996	April, 1996 → April, 1998	October, 1995 → December, 1998
Program Design; Required Areas	Biennial; Split-state; Phoenix/Tucson Centralized Test Only; No testing elsewhere in state	Biennial; Split-state; Test and Repair, with Test only for targeted high polluting vehicles (15% of fleet) in enhanced areas, Test and Repair in basic areas	Biennial for MY 82 and newer; Annual for MY 81 and older; Split-state; Centralized, Test Only in metro Denver; Decentralized, Test and Repair in basic areas; No testing in attainment areas	Biennial; Statewide; Centralized; Test Only	Biennial; Split-state; Decentralized; Test Only and Test and Repair in metro Atlanta; No testing in attainment areas
Testing Equipment	Dynamometer (transient loaded), Remote sensing in Phoenix; Idle test in Tucson	Dynamometer (steady state, ASM) in enhanced areas; idle test in basic areas; Remote Sensing Purge and Pressure	Dynamometer (transient loaded) in enhanced areas (metro Denver) and MY 82 and newer; Two speed idle for MY 81 and older; Gas cap; Visual assessment	Dynamometer (Transient loaded); Purge and Pressure	Dynamometer (steady state ASM) for vehicles 7 years and older (to 1975); Two speed idle for vehicles new to 6 years old; Remote Sensing; Purge and Pressure
Cost	$16.75 subsidized by state; actual cost higher	Test only fee: undetermined Test and Repair: market-based fee	$24-25 in enhanced, $15 in basic areas	$20	Market based with $25 cap

Comparison of Selected State Enhanced I & M Programs -- January 1996

	MARYLAND	NEW JERSEY	NEW HAMPSHIRE	NEW YORK	PENNSYLVANIA
Program Status	Law passed, two subsequent bills passed to delay implementation	Law passed	Program postponed; legislation study pending	Emergency rule extension pending	Governor's proposal
Start/Completion of 1st Enhanced Inspection Period	June, 1997 → June, 1999	January, 1997 → January, 1999		Summer, 1997 → Summer, 1998	1998 pilot, 1999 → 2000
Program Design; Required Areas	Biennial; Split-state: Centralized; Test only; Enhanced Area IM240 (80% of all vehicles); No testing in attainment areas	Biennial; Statewide; Mixed Test only with Repair and Retest		Annual; Split-state; Decentralized; Test and Repair	Annual; Split-state; Decentralized; Test and Repair
Testing Equipment	Dynamometer (steady state ASM) in enhanced area	Dynamometer (steady state ASM); Remote Sensing; Purge and Pressure		Dynamometer (transient loaded) and remote sensing in enhanced areas; Idle test in basic areas Gas cap	Dynamometer (steady state ASM) in enhanced area; Idle test in basic areas
Cost	$17 ($14 cap under current legislation)	Undetermined		Unknown	Market based

Comparison of Selected State Enhanced I & M Programs -- January 1996

	RHODE ISLAND	TEXAS	UTAH	VERMONT	VIRGINIA
Program Status	Fee cap and start date in law. Remainder in staff proposal	Program developed New replacement legislation being developed	Program developed	Governor's proposal (concept to add emissions to existing safety program)	Law passed
Start/Completion of 1st Enhanced Inspection Period	April, 1997 or later → April, 1999	September 1996 → September, 1998	January 1998 → January, 2000	Visual 1996 → OBD 1999	Early 1997 → 1999
Program Design; Required Areas	Biennial; Statewide; Decentralized; Test only with Repair and retest	Biennial; Split-state; Centralized Test Only; Decentralized Test and Repair	Biennial; Split-state; (Four counties, four programs) Decentralized; Test and Repair	Annual; Statewide; Decentralized; Test and Repair	Biennial; Statewide; Decentralized; Test and Repair
Testing Equipment	Dynamometer (transient loaded); Purge	Dynamometer (transient loaded) in enhanced areas; Idle test in basic areas; Reformulated gas Diesel testing in 1997	Dynamometer (transient loaded) in enhanced areas; Idle test in basic areas; Remote sensing	Safety test; Anti-tampering; Pressure; OBD for MY 96 and newer vehicles	Dynamometer (ASM) in metro Washington, DC; Idle test in basic areas
Cost	Undetermined ($25 cap in law)	$8.75 to $13	$14	$10 to $15	$20